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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.
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09/764,880 01/23/01 MATSUKI

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000466 MM91/1019
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EXAMINER

NGUYEN, T

ART UNIT

PAPER NUMBER

2818
DATE MAILED:

10/19/01

Please find below and/or attached an Office communication concerning this application or proceeding.

Commissioner of Patents and Trademarks

Office Action Summary

Application No.

09/764,880

Applicant(s)

MATSUKI ET AL.

Examiner

Thinh T Nguyen

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133).
- Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 23 January 2001.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-6 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-6 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 5B and 6 is/are: a) ☐ accepted or b) ☒ objected to by the Examiner.
- Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
- 11) ☐ The proposed drawing correction filed on _____ is: a) ☐ approved b) ☐ disapproved by the Examiner.
- If approved, corrected drawings are required in reply to this Office action.
- 12) ☐ The oath or declaration is objected to by the Examiner.

Priority under 35 U.S.C. §§ 119 and 120

- 13) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☒ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.
- 14) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. § 119(e) (to a provisional application).
- a) ☐ The translation of the foreign language provisional application has been received.
- 15) ☐ Acknowledgment is made of a claim for domestic priority under 35 U.S.C. §§ 120 and/or 121.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☒ Information Disclosure Statement(s) (PTO-1449) Paper No(s) _____
- 4) ☐ Interview Summary (PTO-413) Paper No(s). _____
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____

DETAILED OFFICE ACTION

Specification

1. The specification is objected to for several reasons:

a/ The applicants claim fig. 2 and 3 (page 10 line 1 to 2) describe the semiconductor device for the first embodiment while at the other part of the specification (page 8 line 1 to 2) the applicants claim fig 2 describes the second embodiment.

Correction is required.

b/ The applicants claim fig. 2 and 3 (page 10 line 1 to 2) describe the semiconductor device for the first embodiment while at the other part of the specification (page 8 line 3 to 4) the applicants claim fig 3 describe the third embodiment.

Correction is required.

c/ The applicants claim fig. 4 (page 13 line 20) describe the second embodiment for the semiconductor device while at the other part of the specification (page 8 line 3 to 4) the applicants claim fig 4 describe the fourth embodiment of the semiconductor device.

Correction is required.

d/ there is no corresponding legend for layer 16 of polysilicon on any of the drawings.

Correction is required.

e/ layer 18 is used to designated both the titanium film (page 12 line2) and polysilicon plug (page 13 line 10).

Correction is required.

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2. The specification has been checked to the extent necessary to determine the presence of all possible minor errors. However, the applicant cooperation is requested in correcting any errors of which the applicant may become aware in the specification.

Drawings

3. The drawings are objected to for the following reasons:

a/ on fig. 5B there is no legend for layer 25 in the specification.

b/ on fig. 6 there is no legend for layer 59 and 60.

Corrections are required.

Claim Rejections - 35 USC § 103

4. The following is a quotation of U.S.C. 103(a) which form the basis for all obviousness rejections set forth in this office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains.

Patentability shall not be negated by the manner in which the invention was made.

5. Claim 1, 2, 4 and 5 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sakao (U.S. patent 618448) in view of Sakoh (U.S. patent 5641991).

REGARDING TO CLAIM 1

Sakao discloses in his invention (fig 3D) a structure for a semiconductor device, provided with a contact plug (fig 3d region 108), which is formed by forming a contact hole (fig 2B region

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106) through a first interlayer insulating film (fig 2D layer 104a) on a silicon substrate and by filling the contact hole with silicon. Although Sakao does not teach the formation of a silicide pad on the top surface of the silicon plug. Sakoh in his invention (fig 2F) teaches the formation of a silicide pad on the top surface of the silicon plug in a self-aligning manner and having a diameter which is larger than that of the silicon plug with the top surface of the silicide pad above the top surface of the first interlayer insulating film. It would have been obvious to one of ordinary skill in the art the time the invention was made to use the teaching of Sakao and Sakoh in order to formulate a structure for a semiconductor device, provided with a contact plug, which is formed by forming a contact hole through a first interlayer insulating film on a silicon substrate and by filling the contact hole with silicon, comprising: a silicide pad formed on the top surface of the silicon plug in a self-aligning manner and having a diameter, which is larger than that of the silicon plug; wherein, the top surface of the silicide pad is formed above the top surface of the first interlayer insulating film.

REGARDING TO CLAIM 2

Sakoh in his invention (fig 2F and column 4 line 19-22) discloses a structure of a semiconductor device with the silicide pad formed by a refractory metal silicide.

REGARDING TO CLAIM 4

Sakao discloses in his invention (fig 3D) a process to fabricate a semiconductor device, provided with a contact plug (fig 3d layer 108), which is formed by forming a contact hole (fig 2B layer 106) through a first interlayer insulating film (fig 2D layer 104a) on a silicon substrate and by filling the contact hole with silicon. Although Sakao does not teach the formation of a silicide pad on the top surface of the silicon plug. Sakoh in his invention (fig

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2F) teaches the formation of a silicide pad on the top surface of the silicon plug in a self-aligning manner and having a diameter, which is larger than that of the silicon plug with the top surface of the silicide pad above the top surface of the first interlayer insulating film. It would have been obvious to one of ordinary skill in the art the time the invention was made to use the teachings of Sakao and Sakoh in order to formulate a method for manufacturing a semiconductor device, provided with a contact plug, which is formed by opening a contact hole through a first interlayer insulating film formed on a silicon substrate and filling the contact hole with silicon, comprising the steps of; forming a first insulating film on specification silicon substrate; forming a contact hole through the first interlayer insulating film; filling specification contact hole with a silicon plug; and forming a silicide pad having a larger diameter than that of the silicon plug in a self-aligning manner.

REGARDING CLAIM 5

Sakao discloses all the method of manufacturing the semiconductor device Except for the steps of depositing a refractory metal film on the protrude part of the Polysilicon plug converting the refractory metal film into the refractory metal silicide by a heat treatment; and removing the refractor metal film remaining without being converted into silicide from the reaction of the products between refractory metal and an atmospheric gas during the heat treatment. However Sakoh teaches (fig 2D through 2F column 5 line 47 and column 6 line 1 to 53) the deposition of a refractory metal film; converting the refractory metal film into the refractory metal silicide by a heat treatment; and removing the refractor metal film remaining without being converted into silicide and reaction

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products between refractory metal and an atmospheric gas during the heat treatment.

It would be obvious for a person of ordinary skill in the art to use the teachings of Sakao and Sakoh in order to formulate the claimed process.

6. Claim 3 and 6 are rejected under 35 U.S.C. 103(a) as being unpatentable over Sakao (U.S. patent 618448) in view of Sakoh (U.S. patent 5641991) and in further view of Iwata et al. (U.S. patent 6291861).

REGARDING CLAIM 3

Sakao and Sakoh disclose all the invention except for the use of cobalt silicide. However Iwata et al show (column 19 line 29-30) the use of the silicide pad with Cobalt As the refractory metal.

It would have been obvious to one have ordinary skill in the art at the time the Invention was made to use the teaching of Sakao, Sakoh and Iwata et al in order to fabricate a semiconductor device, provided with a contact plug, which is formed by forming a contact hole through a first interlayer insulating film on a silicon substrate and by filling the contact hole with silicon, comprising:

a silicide pad formed on the top surface of the silicon plug in a self-aligning manner and having a diameter which is larger than that of the silicon plug; with the top surface of the silicide pad is formed above the top surface of the first interlayer insulating film.

REGARDING CLAIM 6

Sakao and Sakoh disclose all the invention except for the use of cobalt silicide. However, Iwata et al show (column 19 line 29-30) the use of the silicide pad with Cobalt as the refractory metal.

It would have been obvious to one having ordinary skill in the art at the time the invention was made to use the teaching of Sakao, Sakoh and Iwata et al. in order to formulate the fabrication of a semiconductor device, provided with a contact plug, which is formed by forming a contact hole through a first interlayer insulating film on a silicon substrate and by filling the contact hole with silicon, comprising:

A silicide pad formed on the top surface of the silicon plug in a self-aligning manner and having a diameter which is larger than that of the silicon plug; with the top surface of the silicide pad formed above the top surface of the first interlayer insulating film.

7. When responding to the office action, Applicants are advised to provide the examiner with the line numbers and the page numbers in the specification and/or references cited to assist the examiner to locate the appropriate paragraphs.

A shortened statutory period for response to this action is set to expire 3 (three) months and 0 (zero) day from the day of this letter. Failure to respond within the period for response will cause the application to be abandoned (see M.P.E.P. 710.02(b))

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CONCLUSION

8. The prior arts made of record and not relied upon are considered pertinent to applicant disclosure:

Lukanc (US patent 6096644) discloses a self-aligned contacts to sources/drain silicon electrodes using polysilicon and metal silicides.

Lin (US patent 6074921) discloses a self-aligned processing of semiconductor device features.

9. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Thinh T Nguyen whose phone number is (703) 305-0421. The Examiner can normally be reached on Monday to Friday from 8.30 A.M. to 5.00 P.M.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's Supervisor, David C. Nelms can be reached on (703) 308-4910. The fax phone number for the organization where this specification or proceeding is assigned is (703) 308-7724.

Any inquiry of a general nature or relating to the status of this specification or proceeding should be directed to the receptionist whose telephone number is (703) 308-0956.

Thinh T. Nguyen *TTN*

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David Nelms
Supervisory Patent Examiner
Technology Center 2800